Atomic Structure Notes

Introduction

- History behind atomic models & parts
- Discoveries that helped in the discovery
- The parts of the atom
- Models of the Atom

Atomism

- Somewhere about 400 B.C., two Greek philosophers came up with the idea of the atom.
- They were _____

  _____

  (known here after as the two dead Greek dudes).

- Their theory has five statements:

1.All matter is_____

_____

2.There is _____between atoms.

3.Atoms are _____(no space within the atom).

4.Atoms are homogeneous, with_____

5.Atoms are different in _____

_____(added by Epicurus later).

- Summary:

  All did not embrace this idea.
  Aristotle and others wrote against this idea.
  The early Catholic Church also did not like this theory.
  So it kind of disappeared.

Atomic Theory

- The Father of the Chemical Atomic Theory:_____
- He published his theories on the atmosphere and gas behaviour in a book titled *A New System Of Chemical Philosophy*. Only in the last few pages (Chapter III) did he discuss his atomic theory.

◆Four basic ideas in Dalton's chemical atomic theory

1) Chemical elements are _____

2) The atoms of an element are _____

3) Atoms of different elements have _____

4) Atoms only combine in _____

_____

such as 1: 1, 1:2,2:3 and so on.

Explanation of Dalton's Theory

1) Elements are made of atoms.

Elements are made up of minute, _____

_____

These atoms maintain their identity through all _____

_____

2) The atoms of an element are identical in their masses.

Atoms of the **same** element have the _____

_____

Atoms of **different** elements have _____

_____

3) Atoms of different elements have different masses

In other words, while it was claimed atoms of different elements had different weights, no one could figure out what the different weight values were.

Dalton was the first to do so.

4) Atoms combine in small, whole number ratios.

Chemical combination between two or more atoms occurs _____

_____

(i.e., 1 to 1, 1 to 2; 2 to 3; etc.)

This point gives immediate explanation to the _____

_____

_____announced by Joseph Louis Proust in 1797.

This law is sometimes called the *Law of Constant Composition*.

In a modern textbook, it is:

A given chemical compound always contains _____

_____

_____

A different way to say it: _____

_____

_____

Dalton discovered the_____,
another law that is easily explained by his atomic theory.
Dalton discovered this law while studying some of the oxides of nitrogen.
The law, in modern terminology, is:

Atoms of the same element can _____

_____

_____

_____

A fifth idea implicit in Dalton's theory, but usually not discussed is this:

Atoms can be_____

_____

An element's atoms do not change into other element's atoms _____

_____

_____

Other important discoveries

- 1858- William Geissler invents the vacuum pump.
  - This allows scientist to study _____

    _____
  - They studied what were called_____.
- 1879- William Crookes makes the 1st "cathode ray tube".

  Finds that cathode rays _____

_____

_____

- 1886 Edward Goldstein makes a "canal ray tube".

He observes a ray_____

and _____

Concludes _____

- 1891- George Stoney estimates the _____on this unknown negative particle. Calls it the "electrine" which later becomes the "electron"

The Electron

- 1897- J.J. Thomson calculated the charge to mass ratio for cathode rays.

  Figures the rays to be _____

  _____

  (1899 completes work by measuring the charge on the electron)
- 1911- R. A. Millikan directly determined the _____

_____

_____

Once the charge was known, the mass could be calculated.

The electron is assigned the charge _____

- The mass turned out to be _____

_____

If all atoms contain negatively charged electrons, which contribute almost nothing to the mass of the atom, then where is the positive charge needed to make the atom have an overall neutral charge?

The Nucleus

- 1911- Ernest Rutherford found that the atom has _____

  _____

  later determines the nucleus to have a _____

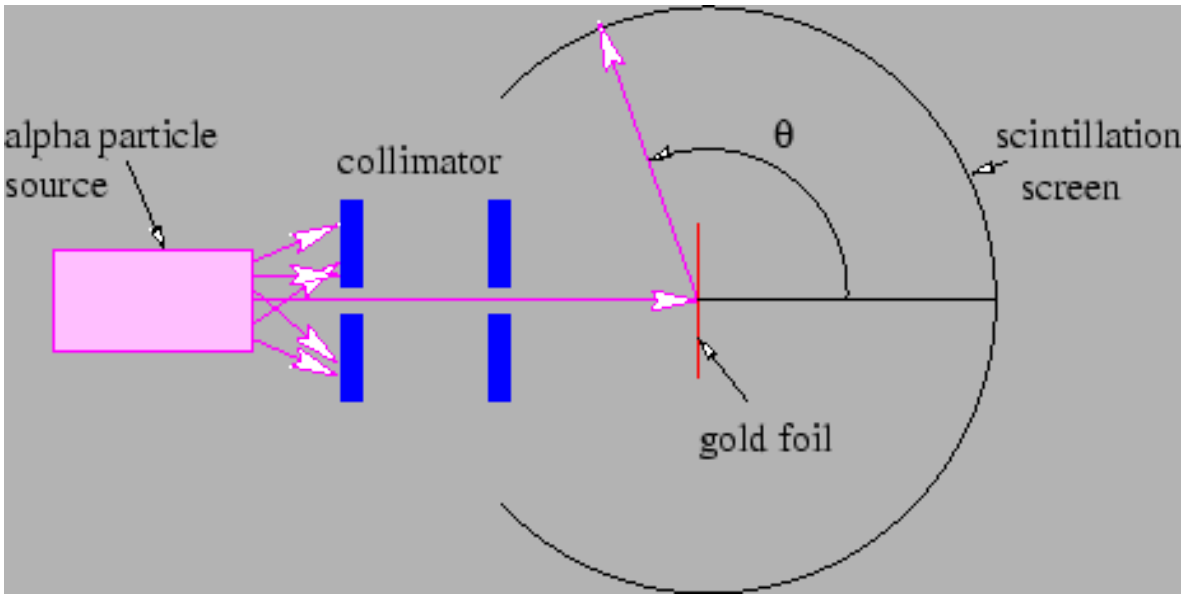
Rutherford's Gold Foil Experiment

The experiment:

Alpha particles were fired_____.

Alpha particles are helium atoms _____

_____



◆Results:

▪Most of the alpha particles went_____

_____

▪Some of the alpha particles were _____

▪Some like 1 or 2 in several thousand _____

_____

◆Rutherford's conclusions:

Atoms_____

The center (nucleus) is _____

The nucleus has_____

More on the Nucleus.

- **Henry Moseley** (1913-14) investigated the characteristic frequencies of X-rays produced by bombarding each of the elements in turn by high-energy cathode rays (electrons).
- He discovered a mathematical relationship that calculated the _____ _____(the "serial number" in the periodic table).
- Also calculated the _____

Atomic number and Protons

- This must mean that the atomic number is _____

  _____

  _____
- Therefore, the atomic number is _____

  _____

  _____
- Moseley was killed in action at Gallipoli in the First World War.

The neutron

- Scientist now had two parts of the atom but they could not account for the mass. Rutherford had predicted its existence but had no laboratory proof of its existence.
- 1932- James Chadwick discovers the neutron.

Bombarded small atoms (Be) with alpha particles and observed _____ _____which were particles similar in mass to protons but had no_____

_____

Hence the neutron (1st named in 1921 by William Harkins)

Atomic Structure: Atoms

- Atoms are made of _____
- The protons and neutrons are held together in _____ _____
- The nucleus is _____ _____
- The nucleus contains 99.9 % of _____
- The electrons are somewhere around the _____ _____
- The size of the atom is_____

Particle	Symbol	Charge	Mass	Location	AMU
Proton	p^+	+1	$1.673X10^{-24}$ g	Nucleus	1
Neutron	n^0	0	$1.675X10^{-24}$ g	Nucleus	1
Electron	e^-	-1	$9.109X10^{-28}$ g	Electron cloud	0

◆Terms:

1.Atoms are _____

_____

_____

2.Isotopes are atoms _____

_____

_____

3.Neutral atoms have no charge (zero) because _____

_____

_____

4. Ions are atoms of an element with_____

_____

_____

due to a difference between _____

_____

5. Mass number is _____

_____

6. Atomic mass is the _____

_____

(all isotopes) and is measured in _____

7. Atomic number is the number _____

This number is _____

◆The Math:

protons = _____

mass# = _____

therefore # neutrons = _____

Charge on an atom: _____

_____

this will be 0 or a small positive or negative number.

Fewer electrons will give an atom _____

More electrons will give an atom _____

Models of the Atom

Greek Model

- 400 B.C.(or somewhere about that time)

Greeks- _____

_____

Dalton's Atomic Model

- early 1800's, John Dalton
- that all matter was composed _____

_____

- that atoms were _____

_____

- Consequently, his model explained that atoms were smaller spheres.
- Atoms go together in _____

_____

Thomson's Atomic Model

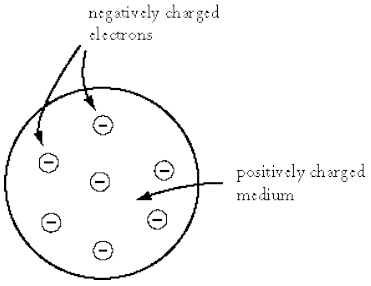
- showed how he thought these electrons were arranged.
- showed that _____

_____

_____

- model of the atom looks like _____

_____



Rutherford's Atomic Model

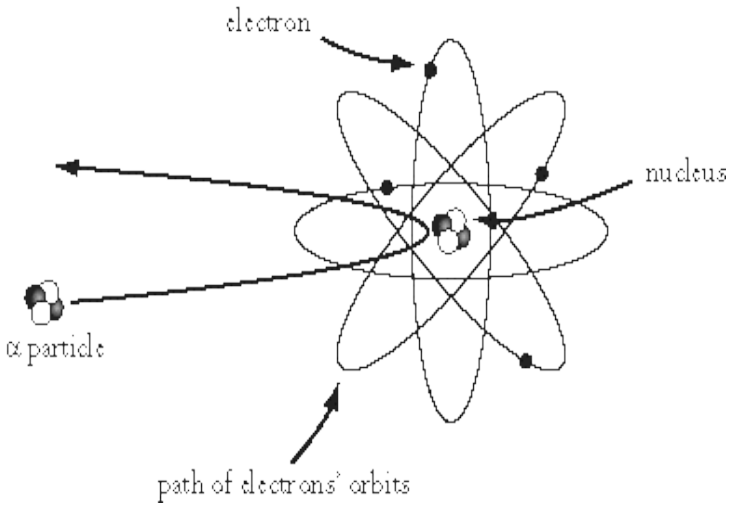
- This model suggested that most of the mass of the atom _____

  _____

- Called _____
- that the rest of the _____
- describes an atom as _____

  _____

  _____



Bohr's Atomic Model

- explained that an atom _____

  _____

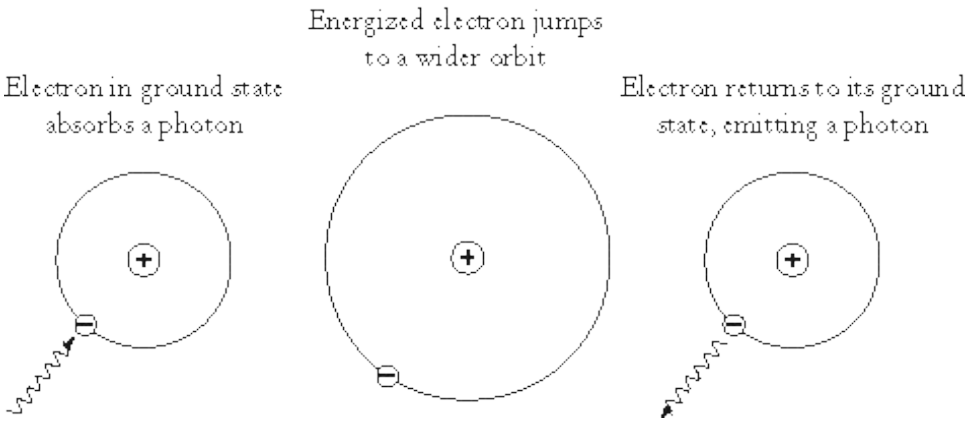
  _____

- This model suggested that the electrons _____

  _____

- Looked like a _____

Bohr's Model



Quantum Mechanical Model of the Atom

- fundamental ideas of _____
- electrons do not actually _____
- the exact location of an electron in an atom_____

only the _____

present day model describes an atom as _____

_____

_____

_____

electron orbitals represent _____

_____

_____

location of an electron depends _____

_____

Electrons are arranged in energy levels within a given electron cloud_____

_____

such that the electrons with the lowest energy _____

_____

and the electron with the highest energy _____

_____